Schedule for contributed talks

Week 1
Monday 6/21

3:20 Perla Sousi University of Cambridge
Collisions of random walks
Regarding his 1920 paper proving recurrence of random walks in $\mathbb{Z}^2$, Polya wrote that his motivation was to determine whether 2 independent random walks in $\mathbb{Z}^2$ meet infinitely often. Of course, in this case, the problem reduces to the recurrence of a single random walk in Z^2, by taking differences. Perhaps surprisingly, however, there exist graphs G where a single random walk is recurrent, yet G has the nfinite collision property: two independent random walks in G collide only finitely many times almost surely. Some examples were constructed by Krishnapur and Peres (2004), who asked whether critical Galton-Watson trees conditioned on nonextinction also have this property. In this talk I will answer this question as part of a systematic study of the finite collision property. In particular, for wedge combs and spherically symmetric trees, we exhibit a phase transition for the finite collision property when growth parameters are varied. Joint work with Martin Barlow and Yuval Peres.

3:50 Russ Thompson Cornell University
Rate of escape on polycyclic groups
Polycyclic groups sit between nilpotent and solvable groups, and in fact every linear group over the integers is polycyclic. Often the behavior of a random walk on a polycyclic group can be understood in terms of a random walk on the integers. Using this observation we will prove a law of iterated logarithm for a class of polycylic groups.

4:20 Yunjiang Jiang Stanford University (40 minute talk)

Mixing time of Kac's random walk

We show that the mixing time of Kac's random walk on the n sphere and special orthogonal group of dimension n are polynomial in n under total variation norm. This is an improvement over the best result before of order n^{2n}. If time permits, I will also discuss results on convergence speed under other metrics, most notably Wasserstein metric. Several open problems will hopefully be discussed in the end as well.

4:15 Federico Polito Department of Statistics, Probability and Applied Statistics

Fractional and Subordinated Branching Processes

We derive the explicit form of the state probabilities for the fractional non-linear pure birth and the fractional linear birth-death processes, generalising the most important classical results. We also present in details a useful and interesting subordination representation for such processes. Furthermore, we analyse the non-linear classical pure birth process and its fractional generalisation, subordinated to various random times. For all of these processes, we derive the state distribution and, when possible, we present the corresponding governing differential equation. We also highlight interesting interpretations in terms of classical birth processes with random rates evaluated on a stretched or squashed time scale.

4:45 Pascal Maillard LPMA, Universit Paris VI, France

The number of absorbed individuals in branching Brownian motion with a barrier

Branching Brownian motion is a continuous-time branching process where the individuals move according to one-dimensional Brownian motions with constant drift. At some point x, we add an absorbing barrier to the process, i.e. individuals touching this point are instantly killed without producing offspring. If the drift towards the barrier is high enough, then this process gets extinct almost surely. I will present recent results about the law of the number of individuals absorbed at the barrier, giving an equivalent for the density of this law. I will also present the main tools used to achieve these results, in particular singularity analysis of generating functions, which is of very general interest.

Thursday 6/24

4:15 Sergey Bocharov Bath University

Branching Levy processes

I shall talk about the asymptotic behaviour of the rightmost particle in Branching Levy processes.

4:45 Tom Alberts University of Toronto

Intermediate Disorder for Directed Polymers in Dimension 1+1

I will introduce a new disorder regime for directed polymers in dimension 1+1 that sits between the well-studied weak and strong disorder regimes. The new regime is called intermediate disorder. It as accessed by scaling the inverse temperature parameter beta to zero as n goes to infinity; the natural choice of scaling is $\beta n^{-1/4}$. Under this scaling, I will show that the polymer measure has previously unseen behavior. In particular, the fluctuation exponents of the polymer endpoint and log partition function are identical to those for simple random walk ($\zeta = 1/2, \chi = 0$), but the fluctuations themselves still depend on the random environment. This effect is most pronounced for the endpoint distribution of the polymer, which I will show converges to a random measure on the real line. This measure is determined by a stationary process that has a very explicit form and is very closely related to the Airy process.

Joint work with Kostya Khanin and Jeremy Quastel.

Friday 6/25

3:20 Sunil Chhita Brown University

Particle Systems arising from an anti-ferromagnetic Ising model

We present a low temperature anisotropic anti-ferromagnetic Ising model through the guise of a certain dimer model. This model has a bijection with a one-dimensional particle system equipped with creation and annihilation. In the thermodynamic limit, the phase behavior is dependent on the anisotropy. Two values of the anisotropy are of particular interest - the critical value and the independent value. At independence, the particles system has the same distribution as the noisy voter model of two colors. Its limiting measure under a certain scaling window with respect to the temperature is the Continuum Noisy Voter Model. At criticality, the distribution of particles on a given horizontal line, under a certain scaling window, is a Pfaffian point process whose kernel is given by Bessel functions.

3:50 Zhongyang Li Brown University

Local Statistics of Realizable Vertex Models

In this talk we study planar vertex models, which are probability measures on edge subsets of a planar graph, satisfying certain constraints at each vertex, examples include dimer model, and 1-2 model, which we will define. A generalized holographic algorithm is applied to reduce the vertex model problem to counting perfect matchings, and conditions under which the vertex model problem can be realized (reduced holographically) to a planar dimer model are discussed. For finite graphs, we express the local statistics of the realizable vertex model as a linear combination of the local statistics of dimers. Using an n by n torus to approximate the periodic infinite graph, we study the asymptotic behavior of the free energy and local statistics of realizable vertex models. The convergence rate of covariance of local configurations is determined when the distance between the two vertices goes to infinity. As an example, we simulate the 1-2 model using the technique of Glauber dynamics.

4:20 Naotaka Kajino Kyoto University

Heat kernel asymptotics for the measurable Riemannian structure on the Sierpinski gasket

Kigami [Math. Ann. 340 (2008), 781–804] has proposed the notion of ‘measurable Riemannian structure’ on the Sierpinski gasket, where the analogues of the basic objects in Riemannian geometry like gradient vector fields and geodesic metrics have been constructed. He has also proved that the associated heat kernel is subject to the two-sided Gaussian bound in spite of the fractal nature of the space.

In this talk more detailed short time asymptotic behaviors of this heat kernel will be established, including Varadhan's asymptotic relation for the logarithm of the heat kernel and a good approximation of it by the usual one-dimensional Gaussian kernel at around each junction point. Moreover, we also discuss the asymptotics of the eigenvalues of the corresponding Laplacian and show that the spectral dimension exists for this case and is equal to the Hausdorff and box-counting dimensions of the gasket with respect to the geodesic metric.

4:50 Nic Freeman Oxford University

Spatial competition driven by Poisson point processes

The Spatial Lambda-Fleming-Viot process describes how individuals living at each point of $\mathbb{R}^d$ might compete over time to colonise their surroundings. Events causing a change in state occur at infinite rate according to dynamics driven by a Poisson point process. I will discuss construction of the process, fractal-like behaviour and scaling limits.

Week two

Monday 6/28

3:20 Kevin McGoff University of Maryland

Random shifts of finite type

Let S be a mixing shift of finite type and let $W_n(S)$ be its set of words of length n. Define a random subset E of $W_n(S)$ by choosing words from $W_n(S)$ (independently, with some probability alpha). Let T be the SFT built from the set E. As n tends to infinity, what can be said about the likely properties of T as a function of α?

We can give answers with regard to the emptiness and entropy of T. Also, for α near 1, the likelihood that T has a unique irreducible component of positive entropy converges exponentially to 1 as n tends to infinity. Note that this version of "random SFT" differs from a notion by the same name studied by Bogenschutz and Gundlach, Kifer, and others, in the broader context of random dynamical systems or bundled dynamical systems."

3:50 Tom LaGatta Courant Institute of Mathematical Sciences

Minimizing Geodesics in Riemannian First-Passage Percolation

Riemannian First-Passage Percolation is a continuum analogue of usual lattice FPP. We use a smooth, matrix-valued random field on the plane to generate a random Riemannian metric g(x) and a random distance function d(x,y). In lattice FPP models, there are many open questions related to the existence of two-sided, globally length-minimizing paths, often called geodesics in the literature. In Riemannian geometry, geodesics are curves which locally minimize length, though not necessarily globally (think of great circles on the sphere). We consider one-sided geodesics starting at the origin in Riemannian FPP, and show that with probability one, the set of directions which yield global length-minimizing geodesics has Lebesgue measure zero. This project mixes techniques from dependent FPP, the theory of continuous disintegrations of Gaussian measures in Banach spaces, and estimates from geometric analysis. This is joint work with my advisor Janek Wehr.

4:20 Hugo Duminil-Copin University of Geneva

Self-avoiding walks on the honeycomb lattice

We will present the proof of a conjecture of B. Nienhuis on the number of self-avoiding walks on the honeycomb lattice. More precisely, we will prove that the connective constant of the lattice equals $\sqrt{2+\sqrt{2}}$. This theorem is the first step towards a deeper understanding of self-avoiding walks. We will state some conjectures on the scaling-limit behavior of these walks.

4:15 Prakash Balachandran Duke University

Learning about Data: From Random Walks and Laplacians to Classification and Clustering

Consider a set of objects endowed with pairwise and higher order relationships. Examples of such objects occur in data sets arising in gene expression data where one has three genes, the activation of each gene which is pairwise independent of each other gene, but the activation of one gene depends on the activation of the other two. Such data sets can be illustrated as a hypergraph, and two natural questions can be asked about it: what are the clusters, and how does one classify the objects? In this talk, we construct random walks on hyperedge sets and assemble them to obtain a random walk on the underlying vertex set. This gives rise to a Laplacian on the vertex set, which we then use in a convex optimization scheme to obtain a smooth classification of the data, and a clustering of the data which respect hyperedge relationships. Results about the use of such empirical operators under noise will also be addressed. This work is joint with Mauro Maggioni at Duke University.

4:45 Ariel Yadin University of Cambridge

Universality for loop-erased random walk

Oded Schramm invented SLE with the loop-erased random walk (or LERW) in mind. LERW is the process obtained by performing a random walk and then erasing the loops in the path obtained. Lawler, Schramm and Werner showed that the scaling limit of LERW is SLE(2), on the euclidean lattice. There proof can be extended to other lattices, but utilizes the lattice structure. We extend this result to a very general family of graphs, proving that the convergence of LERW to SLE(2) is a universal feature, that does not depend on the local structure of the underlying graph.

4:15 Jérémie Bettinelli Université Paris XI, Orsay, France

Scaling limits of uniform random maps

Roughly speaking, a (planar) map is the embedding of a graph in the 2-dimensional sphere. We will restrict ourselves to the special case of maps whose faces all have degree 4. A natural to sample a large random map is to take it uniformly over the set of maps with a fixed number of faces, and then to let the number of faces go to infinity. Endowed with its natural graph distance, a map may be seen as a metric space. We will see during this talk that, once rescaled by the right factor, these random metric spaces converge in distribution, up to extraction, toward a random limiting space called Brownian map. One of the main tools for this study is a bijection due to Schaeffer, which enables to code these maps by trees carrying labels on their vertices. We will present this bijection and spend some time on the limiting space, which uses Aldous's continuum random tree and Le Gall's Brownian snake. We will conclude by some computer simulations.

4:45 Ross Pinsky Department of Mathematics, Technion, Haifa, Israel

Asymptotic Behavior of the Principal Eigenvalue for a Class of Non-Local Elliptic Operators Related to Brownian Motion with Spatially Dependent Random Jumps

Let $D \subset R^d$ be a bounded domain and let $\mathcal{P}(D)$ denote the space of probability measures on D. Consider a Brownian motion in D which is killed at the boundary and which, while alive, jumps instantaneously according to a spatially dependent exponential clock with intensity γV to a new point, according to a distribution $\mu \in \mathcal{P}(D)$. From its new position after the jump, the process repeats the above behavior independently of what has transpired previously. The generator of this process is an extension of the operator $-L_{\gamma,\mu}$, defined by

$$L_{\gamma,\mu}u \equiv -\frac{1}{2}\Delta u + \gamma V C_\mu(u),$$

with the Dirichlet boundary condition, where C_μ is the "μ-centering" operator defined by

$$C_\mu(u) = u - \int_D u \, d\mu.$$

The principal eigenvalue, $\lambda_0(\gamma,\mu)$, of $L_{\gamma,\mu}$ governs the exponential rate of decay of the probability of not exiting D for large time. We study the asymptotic behavior of $\lambda_0(\gamma,\mu)$ as $\gamma \to \infty$. In particular, if μ possesses a density in a neighborhood of the boundary, which we call μ, then

$$\lim_{\gamma\to\infty} \gamma^{-\frac{1}{2}} \lambda_0(\gamma,\mu) = \frac{\int_{\partial D} \frac{\mu}{\sqrt{V}} d\sigma}{\sqrt{2}\int_D \frac{1}{V} d\mu}.$$

If μ and all its derivatives up to order $k-1$ vanish on the boundary, but the k-th derivative does not vanish identically on the boundary, then $\lambda_0(\gamma,\mu)$ behaves asymptotically like $c_k \gamma^{\frac{1-k}{2}}$, for an explicit constant c_k. If μ has compact support, then $\lambda_0(\gamma,\mu)$ satisfies $\exp(-c_2\gamma^{\frac{1}{2}}) \leq \lambda_0(\gamma,\mu) \leq \exp(-c_1\gamma^{\frac{1}{2}})$, for large γ and positive constants c_1, c_2.

3:20 Tonci Antunovic University of California, Berkeley

Brownian motion with variable drift can have isolated zeros

It is well known that one dimensional Brownian motion B does not have isolated zeros. We exhibit a continuous function f such that $B - f$ has only isolated zeros with positive probability. However, for any function f, the zero set of $B - f$ has Hausdorff dimension of at least $1/2$ with positive probability. This is a joint work with Krzysztof Burdzy, Yuval Peres and Julia Ruscher.

3:50 Marcel Ortgiese TU Berlin

Ageing in the parabolic Anderson model

The parabolic Anderson model is the Cauchy problem for the heat equation with a random potential. We concentrate on the case when the potential is given by a collection of i.i.d. random variables with tails that decay polynomially at infinity. In this situation it is known that the solution is essentially localized in a single island.

We show that this system exhibits ageing in the sense

that the periods during which the relevant island remains in the same site grow linearly in time. Furthermore, we also provide a functional limit theorem for the location of the relevant island. This talk is based on joint work with P. Morters and N. Sidorova.

4:20 Weijun Xu Oxford University

The Signature of a Path, and Inversion

Hambly and Lyons introduced the notion of the signature of a path, and proved that paths of finite length are uniquely determined by their signatures up to tree-like equivalence. Based on that, I will also discuss how to reconstruct a lattice path from its signature.

Week three

Tuesday 7/6

3:20 Raoul Normand Laboratoire de Probabilités et Modëles Aléatoires

Post-gelation behavior of a class of coagulation models

We are interested in a class of coagulation models which exhibit the gelation phase transition. Our main interest is the recently introduced model with limited aggregations, where particles are initially given a certain number of arms which are used to perform the coagulations. Their concentrations solve a variant of the standard Smoluchowski's equation. We are interested in the post-gelation solutions to this equation. We shall prove that there is a unique solution, and describe its long-time behavior. We will see that the mean number of arms exhibits an unexpected decrease, and we will compute the limiting concentrations. The latter are related to a discrete random graph model called the configuration model. When there is no gelation, these limit concentrations are easy to interpret with the configuration model. When gelation does occur, a slight modification in the formula appears. This calls for a probabilistic interpretation, which, for now, is unclear.

3:50 Zhu Tianqi Peking University

Efficient Simulation under a Population Genetics Model of Carcinogenesis

We develop an efficient algorithm for simulating the waiting time T_m until m mutations under a population genetics model of cancer development. The algorithm uses an exact algorithm to simulate evolution of small cell populations and coarse-grained tau-leaping approximation to handle large populations. We compared our hybrid simulation algorithm with the exact algorithm in small populations and with available asymptotic results for large populations. Our algorithm is found to be accurate and computationally efficient. We used the algorithm to study the waiting time for up to 20 mutations under a variable population size Moran model.

4:20 Bogdan Dobrzeniecki Institute of Mathematics of the Polish Academy of Sciences

Levy noise driven random string and stochastic heat equation

Levy driven random string is a model of interacting particles system where each particle is driven by the stochastic ODE with both brownian and jump components. Particles interacts one with another via discrete Laplacian rule. I would like to show that this system strongly converges to the stochastic heat eqation driven by Levy noise (as for example defined in Peszat, Zabczyk book on SPDEs with Levy noise, Cambridge, 2007). The proof is based on rather standard techniques from infinite dimensional analysis. This topic may be interesting to both theorists researching random fields as well as applied mathematicians dealing with discretization of SPDEs.

4:15 Anton Klimovsky EURANDOM, TU Eindhoven

Extremes of high-dimensional Gaussian random fields with isotropic increments

In this talk, we report on a rigorous proof of some of the heuristic results of Fyodorov & Sommers (2007) and Fyodorov & Bouchaud (2008) concerning the Gaussian random processes with isotropic increments indexed by high-dimensional Euclidean balls. In particular, we prove an exact variational formula of Parisi-type for the expected values of the extremes. Variational analysis of the optimizer of the formula singles out the following three natural classes of the correlation structures: short-range (power or exponential decay of correlations), critical-range (logarithmic growth of correlations) and long-range ones (power growth of correlations, as in fractional Brownian fields).

4:45 Li Ma Concordia University

On The generalized Feynman-Kac transformation for nearly symmetric Markov process

Suppose X is a right process which is associated with a non-symmetric Dirichlet form (F,D(F) on L2(E;m). For $u \in D(F)$, we have Fukushima's decomposition: $\tilde{u}(X_t) - \tilde{u}(X_0) = M_t^u + N_t^u$. In this paper, we investigate the strong continuity of the generalized Feynman-Kac semigroup defined by $P_t^u f(x) = E_x[e^{N_t^u} f(X_t)]$. Let $Q^u(f,g) = F(f,g) + F(u,fg)$ for $f, g \in D(F)_b$. Denote by J_1 the dissymmetric part of the jumping measure J of (F,D(F)). Under the assumption that J_1 is finite, we show that $(Q^u, D(F)_b)$ is lower semi-bounded if and only if there exists a constant $\alpha_0 \geq 0$ such that $\|P_t^u\|_2 \leq e^{\alpha_0 t}$ for every $t > 0$. If one of these conditions holds, then $(P_t^u)_{t\geq 0}$ is strongly continuous on $L^2(E;m)$. If X is equipped with a differential structure, then this result also holds without assuming that J_1 is finite.

4:15 Brigitta Vermesi IPAM & University of Washington

Brownian motion with drift can be space-filling

It is well known that, for $d > 1$, d-dimensional Brownian motion does not hit points almost surely. Furthermore, for functions $f(t)$ in the Dirichlet space $D[0,1]$, the path $B(t) - f(t)$ has the same almost sure properties as a Brownian path, hence $B - f$ does not hit points. In this talk, we will construct a continuous function $f(t)$ for which $B - f$ not only hits points, but its range covers an open set almost surely.

This is joint work with Tonci Antunovic and Yuval Peres.

4:45 Daisuke Shiraishi Department of Mathematics, Faculty of Science Kyoto University Exact value of the resistance exponent for four dimensional random walk trace

Let S be a simple random walk starting at the origin in $\mathbb{Z}^4$.

We consider $\mathcal{G} = S[0,\infty)$ to be a random subgraph of the integer lattice and assume that a resistance of unit 1 is put on each edge of the graph $\mathcal{G}$. Let R_n be the effective resistance

between the origin and S_n.

We derive the exact value of the resistance exponent; more precisely, we prove that $n^{-1}E(R_n) \approx (\log n)^{-\frac{1}{2}}$.

As an application, we obtain sharp heat kernel estimates for random walk on $\mathcal{G}$ at the quenched level. These results give the answer to the problem raised by Burdzy and Lawler (1990) in four dimensions.